NASA Grant NAG1-1331
Final Report
October, 1996
"High Resolution Doppler Lidar"

Summary of Activities

This Grant supported the development of an incoherent lidar system to measure winds and aerosols in the lower atmosphere. Sample measurements are shown in Figures 1 and 2. During this period the following activities occurred:

- An active feedback system was developed to improve the laser frequency stability.

- A detailed forward model of the instrument was developed to take into account many subtle effects, such as detector non-linearity.

- A non-linear least squares inversion method was developed to recover the Doppler shift and aerosol backscatter without requiring assumptions about the molecular component of the signal.

- A study was done of the effects of systematic errors due to multiple etalon misalignment. It was discovered that even for small offsets and high aerosol loadings, the wind determination can be biased by as much as 1 m/s. The forward model and inversion process were modified to account for this effect.

- The lidar measurements were validated using rawinsonde balloon measurements. The measurements were found to be in agreement within 1-2 m/s.

Ph.D. Students Supported:

Kenneth Fisher
Ph.D. - 1994
Dissertation Title: "A Study of Boundary Layer and Wind Profiles Using Incoherent Doppler Lidar".

Matthew McGill
Ph.D. - 1996
Dissertation Title: "Recovery and Validation of Wind and Aerosol Profiles from Incoherent Doppler Lidar Measurements".

T. D. Irgang
Ph.D. - 1997

Conference Presentations/Proceedings:

Development of an incoherent Doppler lidar for daytime and nighttime measurements (M.J. McGill, W.R. Skinner, T.D. Irgang and V. J. Abreu), Preprint Volume, Ninth AMS Symp. on Meteorological Observations and Instrumentations, Charlotte, NC, March 1995, pp. 117-122.

Wind and aerosol measurements using an incoherent Doppler lidar (T.D. Irgang, W.R. Skinner, M.J. McGill, and V. J. Abreu), Preprint Volume, Ninth AMS Symp. on Meteorological Observations and Instrumentations, Charlotte, NC, March 1995, pp. 123-128.

Incoherent Doppler lidar for daytime and nighttime measurements of winds and aerosols (M.J. McGill, W.R. Skinner, T.D. Irgang and V. J. Abreu), 1994 Fall AGU Meeting, San Francisco, CA, December 1994.

Incoherent Doppler lidar for continuous measurements of wind and aerosol profiles (M.J. McGill, W.R. Skinner, T.D. Irgang and K.W. Fischer), IGARSS '94, Pasadena, CA, August 1994.

Measurements of aerosol loading profiles and mixing layer heights in Atlanta, Georgia during the 1992 SORP-ONA filed study (K.W. Fischer, V. J. Abreu, P. J. Samson, and M.J. McGill), SPIE Proceedings Volume 2122, International Symposium on Optical Sensing for Environmental Monitoring, Atlanta, Georgia, October 11-14, 1993.

Publications:

Use of Multiple Fabry-Perot Interferometers in an Incoherent Doppler Lidar (M. J. McGill and W.R. Skinner), Optical Engineering, June 1996, Accepted for publication.

Validation of Wind Profiles Measured Using Incoherent Doppler Lidar (M. J. McGill, W.R. Skinner and Todd D. Irgang), Applied Optics, March 1996, Accepted for publication.

Analysis techniques for the recovery of winds and backscatter coefficients from a multiple channel incoherent Doppler lidar (M. J. McGill, W.R. Skinner and Todd D. Irgang), Applied Optics, July 1995, Accepted for publication.

Visible Wavelength Doppler lidar for measurement of wind and aerosol profiles during day and night (K.W. Fischer, V. J. Abreu, W. R. Skinner, J. E. Barnes, M. J. McGill, and T. D. Irgang), Opt Eng., **34**, 499-511 (1995).

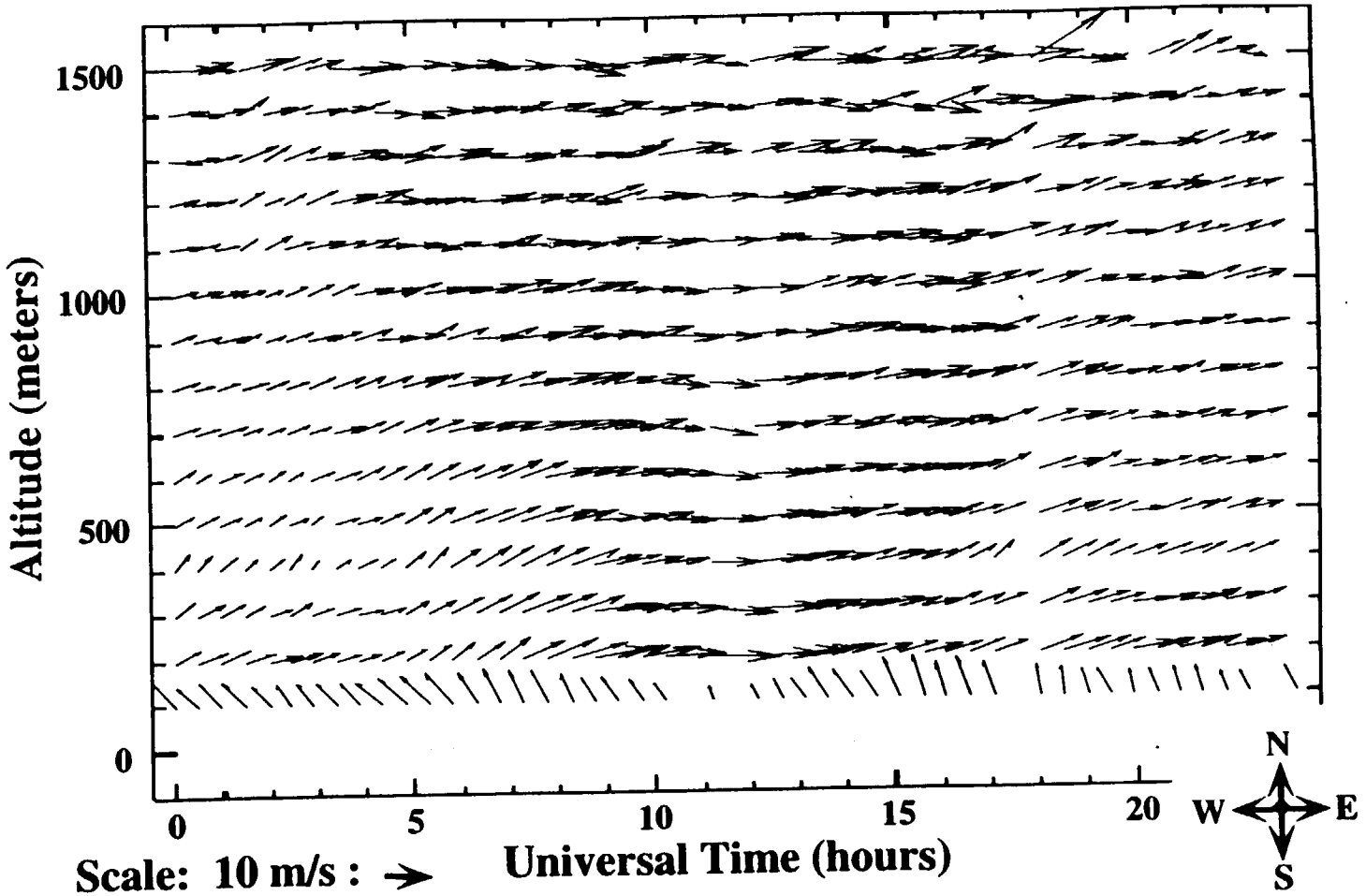

Figure 5.2: Horizontal wind field for the entire day of September 13, 1994, showing half hour average profiles. As denoted by the compass, the positive x-axis represents north and the positive y-axis represents east. For reference, a 10-m/s scale vector is shown in the lower left corner.

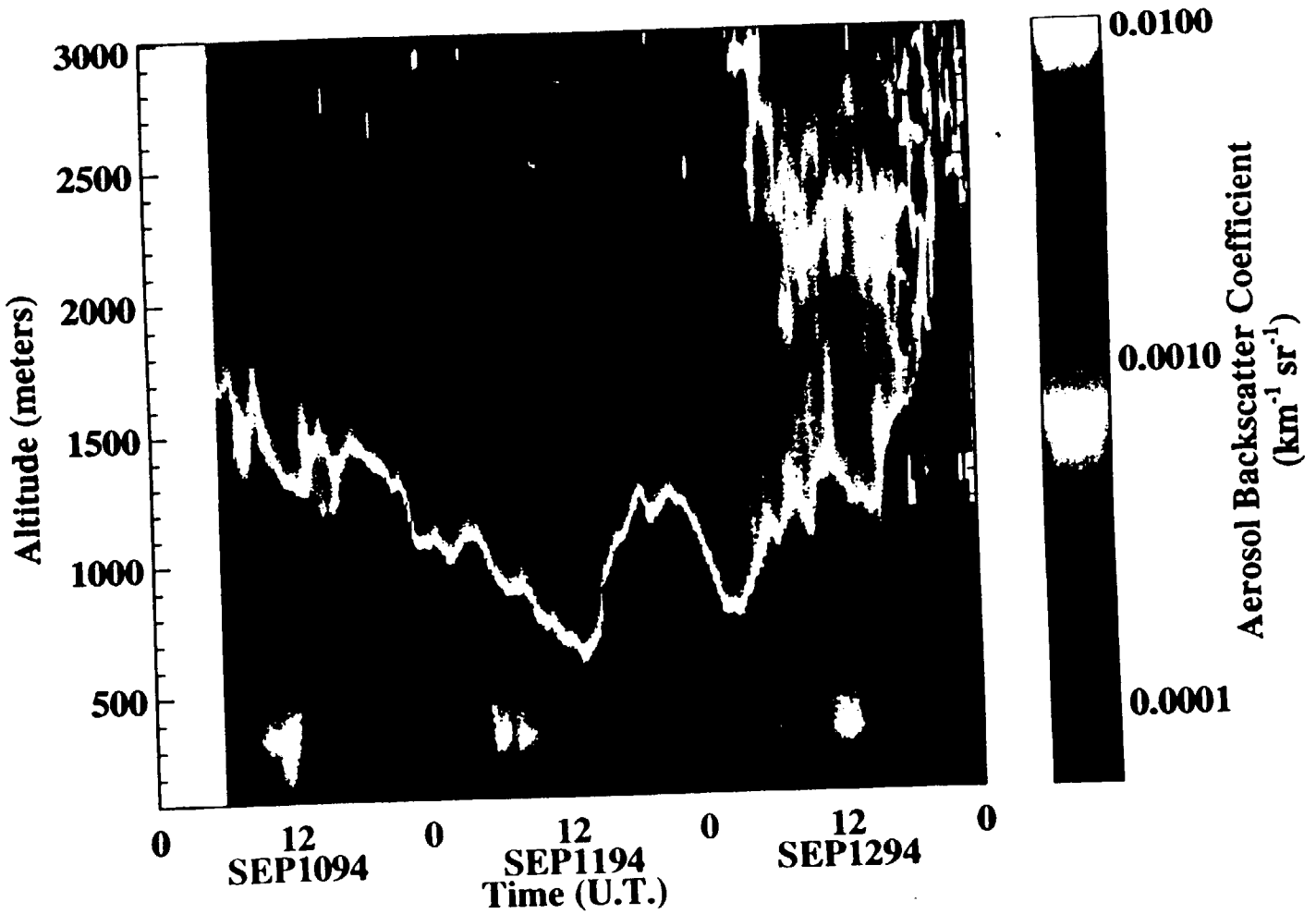

Figure 5.13: Aerosol backscatter for the period September 10 to September 12, 1994, shown as half-hour averages of lidar data.